THE EYE

AS AN AGENT IN CAUSING

HEADACHES AND OTHER NERVOUS DISTURBANCES.

BY

GEO. S. NORTON, M.D.,

PROFESSOR OF OPHTHALMOLOGY IN THE COLLEGE OF THE NEW YORK OPHTHALMIC HOSPITAL.

READ BEFORE THE NEW YORK MEDICO-CHIRURGICAL SOCIETY, DECEMBER 9, 1884. REPRINTED FROM THE HAHNEMANNIAN MONTHLY, JANUARY, 1885.

PRINTED FOR THE AUTHOR.
1885.

THE EYE

AS AN AGENT IN CAUSING HEADACHES

AND OTHER

NERVOUS DISTURBANCES.

WITHIN the past few years, the influence of errors in refraction and weakness of the ocular muscles in producing disturbances in the nervous centres, has assumed more and more importance; all of which is a natural sequence of our increase in knowledge regarding the functions of these organs.

The intimate connection existing between the eye and the brain by means of a nerve of special sense, nerves of sensation and motion, and the blood supply, renders the transmission of an irritation or inflammation in one organ to the other a not unlooked-for consequence. This we see verified in various instances; hyperæmia of the brain will produce congestion in the retinal circulation; tumors in the brain almost invariably cause a "choked disk" or paralysis of one or more of the ocular muscles; and, vice versa, ocular diseases not unfrequently extend to the brain. If this be true regarding inflammatory diseases, how much more certainly should we expect to find symptoms of irritation extending from one to the other. There may not be the same continuity of tissue as is found in the ear, throat and lungs, yet the nerve and blood connection between the eye and brain is closer, and so more conducive to the production of irritation, if not also of inflammation.

The nervous disturbances most commonly brought on by *eye strain* are various forms of headache, particularly in the frontal region, though they may be confined to the vertex, temples or occiput, may be periodical in character, may be accompanied with vertigo and nausea, or may assume almost

any variety imaginable. Besides headaches, various mental disturbances may be observed from this same cause, as depression, irritability of temper and inability to apply the mind; or we may have insomnia, marked indications of spinal irritation, general nervous prostration and even choreic symptoms; all of which will be made more apparent as we proceed.

Let me, however, in the beginning be not misunderstood and considered as one who is "riding a hobby." This has been done by some oculists, and injury worked thereby. It is mere folly to assume that all diseases, or all nervous affections, or all headaches, or even all headaches of a certain type may be cured by attention to the eyes; though there is no doubt that a far larger proportion of nervous headaches and other disturbances are dependent upon the eye than the general practitioner usually realizes.

This subject has been one of great interest to me for years, and several thousand cases* have been examined; and it is from this experience that my conclusions will be drawn, and clinical cases given to illustrate the various points brought forward. In this article none of the inflammatory diseases of the eye will be considered, only the effect of errors in refraction and weakness of the muscles in causing the troubles under discussion.

By the term "refraction" is meant that passive power which every eye possesses, when in a state of rest—*i.e.*, adjusted for its far point—of bringing certain rays of light to a focus upon the retina without any effort of the muscular apparatus of accommodation. This power is due to the form of the eye and its refracting media, the cornea, lens and humors.

By "accommodation" is understood the power which every normal eye possesses of adjusting itself for different distances; thus the accommodation is exercised whenever we change our vision from the distant point by looking at an object near at hand. This power of accommodation is due chiefly to the action of the ciliary muscle, which increases the curvature of the lens, thus enabling it to bring rays to a focus upon the retina.†

In connection with this we must also take into consideration

* By reference to my records I find that during the past three years over 1000 cases of errors in refraction have been examined in my office. This with a practice of ten years previous to that time, and the constant experience in a large clinic at the New York Ophthalmic Hospital will easily make up the "several thousand cases."

† I purposely omit here any consideration of the oblique and remaining recti muscles, as their influence in adjusting the eye for the near point is of little practical importance in comparison with the above.

another important factor, viz., the convergence of the optic axes, which is brought about by the action of the internal recti muscles. Now there is a definite relation between the power of convergence, and the power of accommodation—*i.e.*, we cannot converge our eyes, except within certain limits, without also adjusting them for the near point, and vice versa. If anything interferes with this relation, there will be a strain upon one or the other muscle. Like all other muscles the ciliary and internal recti may become weakened by overuse, when all the symptoms of "eye strain" and its consequences will follow.

In the emmetropic eye, parallel rays of light, viz., those emanating from a distance of twenty feet or more, are brought to a focus upon the retina, without any effort of the accommodation; therefore weakness of the ciliary or recti muscles could only be produced by long-continued use at the near point, especially in low states of the general health. If, upon the other hand, the form of the eye varies from emmetropia so that there is a constant and, perhaps, irregular use of the muscles even for distant vision, and, thereby, an increased action for near vision, very soon we might expect to observe indications of weakness, especially in those whose work demands close application at the near point. The manner in which various errors in refraction produce weakness of accommodation or convergence, will be seen as we proceed.

Before examining into the different errors in refraction, let us first consider how weakness, spasm or irregular action of the ocular muscles can cause headache or other disturbances in the nervous centres. The various muscles of the eye are bountifully supplied with nerves, which preside over muscular action, sensation and nutrition. The nerves of motion are the third, fourth and sixth pairs. The third or oculo-motorius supplies the superior, inferior and internal rectus, inferior oblique, sphincter of the pupil and ciliary muscle. The fourth or patheticus supplies the superior oblique; and the sixth or abducens, the external rectus. The ophthalmic division of the fifth or trigeminus controls the power of sensation in all portions of the eye, and especially acute is this sense in the ciliary region, owing to the ample distribution of these nerve filaments at this point. Sympathetic fibres will also be found in all parts. It will, therefore, be seen that the nerve connections, motory, sensory, and sympathetic, between the muscles of the eye and the nerve centres, are abundant and intimate. Remembering, now, this nerve distribution, is it at all surprising that a constant, regular or irregular strain on the ocular

muscles, week after week, month after month, and year after year, will in time produce headache and various other nervous disturbances by communication of the irritation to other nerve origins? No; it is more astonishing that we do not observe more frequent and more varied complications from eye strain, when we consider the great frequency of anomalies in refraction and the outrageous abuse of the eyes in this intellectual age in which we live.

Having now demonstrated how eye strain will bring about nervous disturbances, let us turn to the various defects of the eye which will cause a strain upon its muscular apparatus.

Hyperopia.

In hyperopia the refractive power is too low, so that, when the eye is in a state of rest—adjusted for distance—parallel rays of light are not brought to a focus upon the retina as in emmetropia, but behind it. An effort of the accommodation is therefore required, even to see objects in the distance distinctly; and how much greater this strain upon the ciliary muscle must be, in looking at a point near at hand, when the accommodation is naturally brought strongly into action. For the emmetropic eye there is a period of rest in viewing distant objects, thus giving time to regain its lost strength after long-continued use at near work, but there is no rest for the hyperopic eye; it must work for distant vision, when it should rest, and must overwork for near vision. Is it, then, to be wondered at that a constant strain is exercised upon the ciliary muscle, which in time will produce various nervous disturbances? The extent of the strain exercised upon the accommodation will depend upon the degree of farsightedness, the amount of work devolving upon the eye, and the general condition of the hyperope. The higher the degree of farsightedness the greater will be the effort of accommodation at the near point, but this does not necessarily hold good for the far point, as they may unconsciously learn to sacrifice a certain amount of distinctness of vision for the advantage of rest. The amount of work is a very important factor in producing asthenopic and nervous symptoms. Steady, long-continued use of an hyperopic eye will invariably, in time, produce eye strain, as will overuse of the muscular apparatus elsewhere cause a corresponding weakness. This is daily demonstrated in our hospital clinics as the poor seamstresses apply for relief of eye and head symptoms due to hyperopia. Usually, the complaint is only of pain in the eyes and headache over them,

after sewing steadily, but occasionally the symptoms become more severe, as in the following:

CASE I.—Agnes M——, aged 17, works at dressmaking from early in the morning till late in the afternoon. She first noticed that the eyes tired on sewing, then a mist would appear before vision about 10 A.M., and continue the remainder of the day; every second day would have a headache over the eyes. These increased in frequency and severity until they came daily at 9 A.M., and continued till night. The pain was severe in the vertex and temples, often shooting in character and accompanied by nervous spells about 2 P.M. Examination showed: V. $\frac{15}{30}$, Hm. (manifest hyperopia) $\frac{1}{30}$. Also, a small degree of astigmatism. As spherical glasses seemed easier than cylindrical, no attempt was made to correct the irregular curvature, but convex 50 were prescribed. Bryonia was given internally. About a month later she reported that she hardly suffered from headache, and could use her eyes with comfort with glasses. If the headache should return in this case, it would be necessary to correct the astigmatism also, as is usually done.

Sewing women are not by any means the only sufferers from headaches due to hyperopia, for it is, comparatively, as commonly, or perhaps more often, observed in school-children or others who are using the eyes steadily (at the near point) in study, or mental exertion. A few cases will give an idea of the symptoms usually complained of by this class of patients, of the low degrees of hyperopia which may produce these symptoms, and of the prompt relief obtained by correction of the error in refraction.

CASE II.—Gracie F——, aged 9, was brought to me in December, 1880, for examination of her eyes on account of headaches, from which she had been suffering for three months since returning to school in the fall. The headaches were of almost daily occurrence, and brought on by long study; V. $\frac{15}{15}$, Hm. $\frac{1}{40}$. Convex 40 seemed easier for reading, and so were prescribed, to be always worn while studying. One month later, received word that she was perfectly cured and could use the eyes without producing headache.

CASE III.—Lizzie S——, aged 12, had been complaining for some time of headache every afternoon while studying, and also of ciliary blepharitis; V. $\frac{15}{15}$, Hm. $\frac{1}{60}$; as convex 60 appeared easy for reading they were prescribed. The headache was relieved for nearly two months, when it again returned, being severe over the eyes. Examination was now

made, after paralyzing the accommodation with atropia, when the whole degree of hyperopia (H.) was found to be $\frac{1}{8}\frac{1}{6}$. Her glasses were exchanged to convex 48, since which time (one year) there has been no return of headache, or inflammation of the lid margins.

CASE IV.—Frank E—— applied in January, 1882, for relief of a constant severe headache in the temples, always aggravated by any use of the eyes. He was very nervous; V. $\frac{1}{1}\frac{5}{5}$, difficulty; concave 50 improved distant vision somewhat. There was no manifest hyperopia (Hm.), but the ophthalmoscope showed that the refraction must be hyperopic, thus indicating a spasm of the ciliary muscle. As convex 40 were comparatively easy to the eyes, they were recommended, and Jaborandi^{m}. was given internally. Two weeks later he reported relief from headache, and that he could use the eyes without trouble with glasses.

CASE V.—Esther W——, about 17 years of age, came to me in February, 1884. She complained that for several months she had been unable to use her eyes for reading; any use of them would produce a hot, burning sensation in the eyes, to be followed by a headache over them, like a tight band, with a dull heavy feeling in the occiput. Occasionally there would be shooting pains through the head, and twitching of the eyelids. There was some photophobia, especially by gaslight, and the conjunctiva would become injected on reading. She had been treated by her physician for "granular lids." V. $\frac{1}{1}\frac{5}{5}$, Hm. $\frac{1}{4}\frac{1}{8}$. Convex 48 were prescribed for near vision. In a few days it was found that these glasses gave only partial relief from the headache, and that prolonged use of the eyes could not be undertaken, owing to the weakness of the accommodation. Systematic exercise of the eyes, according to "Dyer's method," reading regularly twice a day, commencing in this case with fifteen minutes (her limit), and increasing one minute each day as long as it could be done with comfort, was advised; at the same time electricity was employed, and various remedies, as Con., Ruta, Nux, Bell., and Calc. phos., were administered. She improved steadily and rapidly. In October she wrote that her "eyes had been well all summer;" had used her glasses as directed for near vision; could read an hour and a half without discomfort, and only occasionally suffered from a headache, which could always be ascribed to some definite cause unconnected with the eyes.

CASE VI.—Miss M. D—— was seen in October, 1883. She said that reading ten or fifteen minutes would produce a

sharp pain through the right eye, followed by a drawing pain in the head, and headache over the eyes, with occasionally some pain in the occiput. V. $\frac{15}{15}$, difficulty, Hm. $\frac{1}{40}$. Convex 40 were given for near vision, and Ruta administered internally. In October, 1884, she reported that all the head-symptoms had been relieved, and she could use the eyes by day as much as she desired.

Case VII.—Fred. T——, about 16 years old, came to my office in September, 1879. He had not been able to use his eyes for several years without producing headache, and for six weeks had complained of marked spasm of the lids on reading. After reading ten minutes there would be aching around and behind the eyes, soon followed by frontal headache. V. $\frac{20}{20}$, Hm. $\frac{1}{40}$. Being satisfied that his hyperopia was really much more than this, convex 50 were prescribed, and systematic exercise recommended. For the spasm of the ciliary muscle Jaborandi was given. Within two months he was able to use his eyes without discomfort, and his headache and nervous symptoms had disappeared. A little over a year later it was necessary to change his glasses to convex 40, but with this exception he has experienced no trouble.

In the above series of cases it will be noted that only those have been selected in which the hyperopia has been of a low degree, and in all of which the vision has been perfect (V. $\frac{15}{15}$ or $\frac{20}{20}$). This has been done intentionally; for they more forcibly illustrate the importance of this error of refraction in causing head symptoms, and therefore the necessity of suspecting it even when the vision is normal. In the higher degrees of hyperopia attention would be sooner directed towards the eyes, as the sight is more or less involved, both for distant and near objects. The train of head-symptoms is, however, very similar to those given above, only perhaps more pronounced.

In all hyperopes the constant strain to correct the error in refraction is necessarily chiefly exercised upon the ciliary muscle. This strain will, in some instances, produce simple weakness of the muscle; in others a condition of chronic spasm. The latter is very common, and is a form of "irritable weakness," the muscle being in a state of tension and irritability which especially induces headache and other nervous symptoms. In either condition the correction of the hyperopia is of first importance. Afterwards remedies may be required according to the character of the muscular affection.

The recti muscles are not so frequently involved in farsightedness as in nearsightedness, still their relative strength

must often be taken into consideration as will be shown further on.

The general condition of the patient must not be overlooked; for the exciting cause of the head and nerve-symptoms will not unfrequently be found in a poor state of the health. The muscles may have been so strong that they have been able to withstand the extra amount of work laid upon them until all at once some constitutional disturbance weakens the overworked muscles, and develops the symptoms of eye strain.

Myopia.

Myopia is the opposite condition of hyperopia, *i.e.*, the refractive power is too high, or the antero-posterior axis too long, so that parallel rays of light are not brought to a focus upon the retina but in front of it. The effort of accommodation is, therefore, even less than in emmetropia, both for distant and near objects, so we would not expect to find headaches arising from overwork of the ciliary muscle. Thus we must ascribe the headaches which are observed, though less often than in some other anomalies of refraction, to some other cause than strain upon the accommodation as in hyperopia. First, in high degrees of myopia, which necessitate bringing the book nearer the eyes than usual, an extra effort of convergence is required, thus occasioning undue strain on the internal recti muscles, which is followed by weakness of these muscles with its attendant train of asthenopic, nervous and cerebral symptoms. Second, in the progressive myopia of young people, there will be found congestion of the fundus and even of the whole eye, sensitiveness to light and use, and other symptoms of irritation and weakness which may easily be transmitted to the nerve-centres. Illustrative of these varieties are the following cases:

Case VIII.—Miss M. W——, æt. 27, school teacher, had suffered for years from severe sick headaches. Would be confined to the house (often in bed) for one or two days each week. They usually came on about Friday, after teaching all the week. The pains were intense throughout the whole head, seeming as if they would drive her crazy, and were only relieved by anodynes. The patient was very nervous and delicate. V. $\frac{6}{200}$. M. $_{4}\frac{1}{36}$ with which V. $\frac{15}{20}$. The fundus appeared normal, with the exception of a very slight posterior staphyloma. The internal recti were weak. Concave 10 were prescribed for constant use, and Jaborandi was given

internally. She has been now under treatment about four months, and reports wonderful improvement. The headaches have not wholly disappeared, but are less frequent and less severe; she is stronger, less nervous, and sleeps better than formerly.

Case IX.—Ella L——, age about 13, came for attention to eyes in April, 1882. She complained of severe pain over the eyes in the head on reading two hours or so. Relief was only obtained by sleep. V. $\frac{20}{25}$, M. $\frac{1}{12}$, V. $\frac{12}{12}$. It was a case of progressive myopia. The fundus was hyperæmic and outlines of optic papilla blurred, though no marked posterior staphyloma could be detected. Concave 18 were recommended for constant use. In October, 1884, she reported herself as perfectly well, could read four or five hours without discomfort, and did not suffer from her former headaches.

Again, in another series of cases, spasm of the ciliary muscle will simulate myopia, and play a very prominent part in the causation of nervous disturbances. These patients may be really myopic, but of a lower degree than is apparent, or they may be emmetropic, astigmatic or hyperopic. This condition must always be borne in mind in myopia, especially when changeable in degree, for it must not be neutralized by correcting lenses, but relieved either by the local use of atropia or the administration of internal remedies, particularly Jaborandi. As examples of spasm of the accommodation, the following cases are cited:

Case X.—Mr. R——, æt. 28, for seven years had been writing in a poor light all day. He thought his nearsightedness had appeared within one or two years. He complained of the myopia increasing, and the eyes tiring on using them one and a half hours. Fundus normal. V. $\frac{20}{70}$. Concave 40, V. $\frac{20}{20}$. Three weeks after using Jaborandi[m], he reported that he had used his eyes more than usual, and had experienced no trouble. V. $\frac{20}{20}$. Concave 50, V. $\frac{20}{20}$. Thus proving that we had a case of myopia with spasm of the ciliary muscle.

Case XI.—Mr. M——, æt. 32. V. $\frac{20}{30}$. Concave 42, V. $\frac{20}{20}$. For nine months had had spots before the vision and aching of the eyes upon using them. In three days, under Jaborandi[m], the vision had become $\frac{20}{20}$, and the muscæ volitantes had disappeared, thus verifying the diagnosis of emmetropia with a simulated myopia from spasm of the accomodation.

Case XII.—James L——, æt. 32, complained of every-

thing becoming black before the eyes on stooping; aching of the eyes on reading, and spots before the vision. V. $\frac{15}{15}$. Concave 42, V. $\frac{20}{15}$. Ophthalmoscope showed slight hyperopia. Three days after taking Jaborandi [1], all the symptoms were relieved, and V. $\frac{20}{20}$.

The influence of regular and irregular spasm of the ciliary muscle will be further considered under astigmatism.

Astigmatism.

This anomaly is one in which the refraction varies in the different meridians of the same eye, and is dependent chiefly upon a variation in curvature of the cornea in its two principal meridians. Irregular curvature of the cornea or lens in more than two meridians is purposely excluded from this classification. Under the term "regular astigmatism" we may distinguish six different forms, viz.: simple myopic astigmatism (Am.); simple hyperopic astigmatism (Ah.); compound myopic astigmatism (M. + Am.); compound hyperopic astigmatism (H. + Ah.); mixed astigmatism, with predominant myopia (Amh.); mixed astigmatism, with predominant hyperopia (Ahm.)

Astigmatism will more frequently induce headaches and various nervous disturbances than any other error in refraction. This is, however, no more than we could anticipate, when we remember that the ciliary muscle must act irregularly in the different meridians, thus sooner or later occasioning eye strain with its accompanying symptoms. The eye always endeavors to obtain distinctness of vision, and in small degrees of irregular curvature it may approximately accomplish this result, though at the expense of a strain upon the accommodation. It is remarkable how small a deviation from the normal curvature will, under favorable circumstances, produce serious eye and head symptoms. Not many years ago, an astigmatism of $\frac{1}{10}$ was considered normal, and not necessary to correct. Now, we know that an astigmatism of $\frac{1}{12}$, or even $\frac{1}{144}$, may occasion very marked asthenopic and nervous symptoms. This is especially true when the degree of abnormal curvature varies in the two eyes, and in different meridians, as is quite commonly the case; for, in these instances, the strain upon the ciliary muscle will be unequal in the two eyes, thus complicating the difficulty. In the higher degrees of astigmatism the patient generally applies for relief early, on account of the poor sight, thus avoiding headache.

Definite knowledge as to the condition of the ciliary muscle,

is very necessary in prescribing cylindrical lenses; for this muscle may have become so accustomed to acting irregularly, that irregular contraction has become the rule, and its complete relaxation impossible without artificial aid, thus preventing us from obtaining correct information as to the curvature of the cornea. It is, therefore, always advisable to make an examination after fully paralyzing the accommodation with atropine; particularly is this essential in low degrees of myopic astigmatism.

Let us now consider the different varieties of this error in refraction.

Simple Myopic Astigmatism (Am.) is that state of refraction in which myopia exists in one principal meridian, and emmetropia in the other. The influence of this abnormal curvature upon the nerve centres is well demonstrated in the following case:

Case XIII.—Arthur F——, about 17 years of age, came to me in September, 1878, complaining of a constant aching in the eyes aggravated upon reading, also a pain over them after any use, followed by headache, nausea, and general feeling of illness. V. $\frac{20}{20}$. No Hm., but as convex 60 seemed easier to the eye, they were prescribed. At that time no test was made for astigmatism, as it was not then thought necessary when vision was perfect. The above glasses, with Ruta or Nat. mur. internally, gave comparative relief for several months. After which the patient was not again seen until March, 1883, when he once more came by the advice of his physician, to see if there could be any trouble with his eyes. He stated that he had never been wholly free from attacks of headache, but, for the past two months it had been constant, especially in the frontal region. At times it would be severe, with nausea and vomiting. It was always increased by use of the eyes, or from any mental exertion. He became despondent, sleepless at night, generally "run down" in health, and totally unfitted for his business (mercantile). He had been under the best medical advice, "neurasthenia" diagnosticated, and a trip South recommended. He had taken the last prescription, and been to Florida for three or four weeks, but with only slight temporary relief while away; all the symptoms returning in full force on his return to business. Examination now revealed R. V. $\frac{1}{3}$, L. V. $\frac{1}{2}$ difficulty. No improvement from spherical glasses could be obtained. As straight lines did not appear exactly the same in all meridians, it was decided to test under atropine, which was to be instilled in both

eyes the night and morning before he again came. In a few days he returned, with the accommodation fully paralyzed. R. V. $\frac{15}{40}$, L. V. $\frac{15}{20}$; —40° axis 90° (vertical), R. V. $\frac{15}{15}$, and lines correct in all meridians; —144° axis 90°, L. V. $\frac{15}{15}$ and lines correct. After a further test, on his recovery from the atropine, "O. D. —48° axis 90°, O. S. —144° axis 90° " were prescribed for constant use. After wearing these glasses a few days, the headache and all other nervous disturbances had been relieved, even though business had been resumed. Three months later, he reported "complete relief from all headache, sleeps well, and general health as good or better than ever;" also, that, upon attempting, for three weeks, to do without his glasses, indications of his former troubles had returned, which were at once relieved by putting on his glasses again. In September, 1884, he came in to say that there had been no return of former headaches, wears his glasses constantly, and can use his eyes all he desires.

It must always be remembered that spasm of the ciliary muscle will not unfrequently make a hyperopic astigmatism appear to be myopic; it is therefore never safe to prescribe weak cylindrical glasses without an examination under atropine.

Simple Hyperopic Astigmatism (Ah.) is that condition of the refraction in which hyperopia exists in one principal meridian and emmetropia in the other.

Illustrative of the results consequent upon this anomaly of refraction, and of the benefit derived from its correction, the following cases are given:

Case XIV.—Mrs. A. C——, æt. 36, dressmaker, was sent to me in October, 1883. For eight months she had not been able to use her eyes with comfort, and had much pain over the eyes in head, especially at menstrual period. Dysmenorrhœa. V. $\frac{15}{15}$. No Hm. She could not at that time have an examination made under atropine, so prescribed convex 50 which gave some relief. Her headaches, however, increased in frequency and severity; sometimes being constant over the eyes with nausea, especially in the morning; again there would be a dull feeling extending down the back of the neck; they were always made worse from any use of the eyes, mental worry or excitement. In January, 1884, the test was made under atropine. V. $\frac{15}{30}$. O. D. + 30° axis 90° V. $\frac{15}{15}$ and lines correct. O. S. — 48° axis 90° V. $\frac{15}{15}$ and lines correct. These glasses were prescribed though not perfectly comfortable at first. Within a few days, however, they were worn with ease, and

gave relief from all head symptoms. October, 1884, uses her eyes all day without trouble. Does not suffer from the former severe headaches, only occasionally a dull feeling in forehead and vertex from overwork. She only uses glasses for reading or sewing.

CASE XV.—Effie H——, æt. 15, had been sick for one and a half years from "nervous prostration and spinal irritation." She had received the best medical advice, but had obtained comparatively little relief. She suffered from headache and much pain in the back, aggravated by any exertion physical or mental, and especially by excitement or use of the eyes. On reading three minutes there would be a blur before vision, followed by pain in the eyes extending to head and back. R. V. $\frac{1}{20}$, L. V. $\frac{1}{11}$. Convex 72° axis 100° made vision $\frac{1}{11}$ in both eyes and lines at first correct, but they soon changed. This was in April, 1884. A further test was then made under atropine, with this result: R. V. $\frac{1}{20}$, + 60° axis 95° R. V. $\frac{1}{11}$ and lines correct. L. V. $\frac{1}{20}$, + 72° axis 90° L. V. $\frac{1}{11}$ and lines correct. Before recovering from the atropine, these glasses were prescribed for constant use, and she was allowed to return to her home in the middle of the State. In October, 1884, her father wrote me that she was still wearing the glasses constantly, and could read an hour with comfort; also, that "the headache is all gone, and her back is a great deal better. It does not ache except when she is tired."

That a still smaller degree of abnormal curvature may cause very decided eye and head symptoms is shown in the next case.

CASE XVI.—Lucy E——, about 17 years old, came to my office in November, 1882. For one year had had much pain in the eyes on reading. The eyes were weak, sensitive to light, especially gaslight, which caused redness of the eyes the following day. The lids felt heavy, and she desired to close them. On reading even five minutes, a blur would come before the vision, to be followed by headache over the eyes. Nearly every afternoon had pain through the temples coming and going quickly. V. $\frac{1}{3}$, with slight difficulty; + 144° axis 90° made vision $\frac{1}{3}$ and corrected the slight blurring of vertical lines. These glasses were at once given for both distant and near vision. Immediate relief from headache and all eye symptoms was experienced. October, 1884, she wrote that she was still using the glasses, and could not read an hour with comfort without them. No pain in the eyes, or headache unless she neglected to wear her glasses.

One more case under this heading will illustrate the importance of spasm of the ciliary muscle and the necessity of making an examination under atropine.

Case XVII.—Mrs. B——, aged about 30, was seen for the first time in August, 1883. Was of a nervous temperament, and had for years complained of headache, painful menstruation, and various nervous disturbances. In 1881 an oculist had given her + 36° axis 90° ⌒ — 48° axis 180° for right eye, and — 48° axis 180° for left eye. These had given perfect relief for a year, but when I saw her the old symptoms were returning. There was sharp pain over and behind the eyes extending into the head; drawing sensation as if the eye were being drawn back into the head; pain after sleeping; darting pain down the nose; tired feeling in the occiput; some photophobia; considerable nausea and nervousness; print blurred on any attempt to read. Use of the eyes for near vision aggravated all the symptoms, and she was always worse during menses. R. V. $\frac{15}{40}$, L. V. $\frac{15}{30}$. The glasses she was wearing seeming to improve the vision more than any others, a test under atropine was decided upon. After its instillation for twelve hours R. V. $\frac{15}{20}$, L. V. $\frac{15}{70}$; + 16° axis 90° R. V. $\frac{15}{20}$, + 24° axis 90° L. V. $\frac{15}{15}$, and lines were corrected in both eyes. After coming out from under the influence of the mydriatic it was found to be impossible to completely neutralize the irregular curvature, as the ciliary muscle had so long acted irregularly that it could not relax. + 30° O. D., and + 48° O. S., axes 90°, were as strong as could be worn with comfort. These were prescribed for constant use, and after the eyes had become accustomed to them, about five months later, they were changed to + 20° O. D., and + 36° O. S., axes 90°, which have been used to present time with relief from all former symptoms.

Compound Myopic Astigmatism (M. ⌒ Am.).—In this form myopia exists in both principal meridians, but it varies in degree. This anomaly of refraction, as can be readily understood, will produce more serious complications than any of the preceding varieties, for we have the "combination strain" from both the myopia and the myopic astigmatism. The former induces overuse of the internal recti muscles, while the latter, at the same time, causes an irregular action of the ciliary muscle. The following cases will show its importance in the production of nervous disturbances:

Case XVIII.—Lucy D——, aged 18, was sent to me in May, 1884, for examination of her eyes on account of severe headaches. For three or four years she had not been able to

study or do any work without producing much headache and pain in the back. For a long time the headache had been constant, but made very much worse from riding in the cars or from any excitement. She was nervous, despondent, and complained of much backache. R. V. $\frac{10}{200}$, L. V. $\frac{15}{200}$. Had been using —10 glasses. Examination revealed a high degree of compound myopic astigmatism, but, as the test was variable, a further examination under atropine was recommended. Two days later it was made, with the following result: R. V. $\frac{8}{200}$, L. V. $\frac{15}{200}$; O. D. —9^s ⌒ —12^c ax. 180°, V. $\frac{15}{60}$, and lines correct; O. S. —14^s ⌒ —12^c ax. 20°, L. V. $\frac{15}{40}$, and lines correct. One week later, she reported that her headaches were relieved while under the influence of the atropine, but had now returned, so that she was suffering when in my office. The following were now found to give the most relief, and were prescribed for constant use: O. D. —12^s ⌒ —12^c ax. 180°, O. S. —16^s ⌒ —12^c ax. 180°. Clearness of vision for the lines had to be sacrificed for ease in the left eye by changing the axis from 20° to 180°. Upon using these glasses for fifteen or twenty minutes in my office, her headache had nearly disappeared. One month later, her mother reported that the result was marvellous. "There had been no headache since wearing the glasses, no pain in the back, and her general health was rapidly improving." The improvement has since continued, I learn.

In this instance, all the astigmatism, but only a portion of the myopia, was neutralized. This is usually advisable, but occasionally all the error may be corrected, as in the next case.

Case XIX.—Mrs. M——, 41 years of age, was seen in June, 1884. She had suffered for many years from headache, and various nervous troubles. About five years ago the following glasses had been prescribed: O. D. —20^s ⌒ —36^c ax. 180°, O. S. —12^s ⌒ —24^c ax. 180°, for distant vision; and O. D. —30^s ⌒ —24^c ax. 180°; O. S. —14^s ⌒ —24^c ax. 180°, for reading. These had given great relief until the past year, when her former symptoms had again appeared. She could not read fifteen minutes without smarting, burning, and aching in the eyes, pain in the temples and back of the head, with pain extending down the spine to the ovarian regions. There was also nausea upon looking at objects when riding. Menses were early and profuse. The test under atropine revealed the following: V. $\frac{15}{200}$. O. D. —24^s ⌒ —20^c ax. 180°, V. $\frac{15}{15}$, and lines correct; O. S. —13^s ⌒ —20^c ax. 180°, V $\frac{15}{15}$, and lines correct. After recovering from the mydriatic, these

glasses were prescribed for distant vision, and O. D. —72 ⌒ —20 ax. 180, O. S. —20 ⌒ —20 ax. 180, for near vision. In October she wrote that the headaches and other symptoms were almost wholly relieved, and that she could read for two hours without discomfort. Regular exercise has been followed, and Silicea given internally.

Again, it will sometimes be found advisable to only correct the astigmatism.

Case XX.—Mrs. T—— for years had had ciliary blepharitis, and tiring of the eyes and head upon reading or sewing. R. V. $\frac{15}{100}$, L. V. $\frac{15}{200}$. Her M. was $\frac{1}{18}$ in the right eye, and $\frac{1}{13}$ in the left eye, with Am. in both eyes of $\frac{1}{3.0}$ in vertical meridian. Under atropine the myopic astigmatism was found to be the same; but the myopia was decreased to $\frac{1}{24}$ in the right eye, and $\frac{1}{20}$ in the left eye, thus showing a spasm of the accommodation. —30 ax. 180 were prescribed for constant use, but especially for reading. One month later, she could use her eyes as much as she desired without trouble, and the blepharitis was nearly well. Ung. hydrarg. ox. flav. had been used locally, and Jaborandi administered internally.

Compound Hyperopic Astigmatism (H. + Ah.) is that form of abnormal curvature in which hyperopia exists in both principal meridians, but more in the one than in the other. This error in refraction is of frequent occurrence, much more frequent than is usually supposed; and many of the so-called cases of simple hyperopic astigmatism would prove to be compound were they examined under atropine. The strain upon the ciliary muscle, which especially gives rise to headaches and nervous symptoms, is more pronounced in this variety of astigmatism than in any of the preceding, for we have the constant overuse of the accommodation from the hyperopia in connection with its irregular overaction from the astigmatism.

As examples of this form of anomaly of refraction the following cases are given:

Case XXI.—Mr. J. S——, æt. about 35, came to me in October, 1883. For years he had been subject to severe headaches, aggravated by any use of the eyes. About a year previous to his coming to me, cylindrical lenses of + 36 O. D., and + 48 O. S., had been given, and had afforded him partial relief. Still, the headaches were severe, especially in the frontal region, and were always aggravated on the day following overwork of the eyes in the evening. The headaches seemed to be congestive in character, with heat and flushing of the face. The pain was sometimes heavy, and again "pounding," or sore over the eyes, made worse by motion, noise, or light. The

eyes, at these times, would feel bruised and sore to touch. Sometimes there would be nausea and faintness. An examination, made after instillation of atropine, revealed compound hyperopic astigmatism. The following glasses, which corrected all the astigmatism, and nearly all the hyperopia, were prescribed: O. D. +48ˢ ⊂ +36ᶜ ax. 135°; O. S. +48ˢ ⊂ +48ᶜ ax. 45°. Remedies, as Ruta, Bell., Arg. nit., and Gels., were given for a month or so. In October, 1884, he wrote me: "I have little or no trouble whatever with my head. The headaches have ceased entirely since undergoing treatment for my eyes. Of course I have to wear my glasses constantly, but that to me is of small account when I think of those awful headaches. I can truly say that I never felt better in my life."

Case XXII.—Mrs. V—— had not, for three or four years, been able to use her eyes without pain in them, and severe headache. On reading one day would awake the next morning with a pain in the occiput, and a feeling in the vertex as if it were sinking in. On looking steadily, there would be aching through the eyeball. The test under atropine was O. D. +36ˢ ⊂ +36ᶜ ax. 90°; O. S. +36ˢ ⊂ +36ᶜ ax. 80°. The cylindricals, which only corrected the astigmatism, were advised for constant use. One year later she reported that she wore the glasses constantly with great relief, and that she had suffered from only one headache since wearing them. As the eyes tired soon on reading, +40ˢ were combined with her glasses for reading.

In the above case it will be observed that only the astigmatism was neutralized. This is often advisable in the beginning, though later, when the ciliary muscle has become accustomed to acting regularly, it may be necessary to also correct the whole or a portion of the hyperopia. One case more will show the result of a smaller error in refraction.

Case XXIII.—Miss S—— came for examination of her eyes on account of periodic sick headaches. The pain was severe every week or so, in forehead and temples, accompanied with nausea and vomiting. Did not complain of eyes except of a slight aching occasionally after reading one or two hours or longer. The test under atropine made apparent a compound hyperopic astigmatism, corrected by +72ᶜ ⊂ +72ᶜ ax. 90°. Convex 72ᶜ ax. 90° were prescribed for constant use. Three months later she stated that the glasses had only been worn for reading, but that her headaches were much less severe and less frequent in occurrence.

Mixed astigmatism is a rare form in which one principal meridian is myopic, and the other hyperopic. Two divisions may be made of this class; in one the myopia predominates (Amb.), while in the other hyperopia predominates (Ahm.).

This form of astigmatism naturally gives rise to more irregular action of the accommodation than any other, thus necessarily involving greater eye strain.

One case of each variety will illustrate its influence on the nerve-centres.

Case XXIV.—Mrs. W—— had been suffering for two or three years from dimness of vision, headache, etc., and had been treated with benefit by an oculist for intraocular troubles. In May, 1884, she came to my office, complaining of headache in the occiput with nausea after long use of the eyes. Often there was pain in the back of the neck extending down the spine. The ophthalmoscope showed some floating opacities in the vitreous, but fundus otherwise normal. R. V. $\frac{15}{20}$, L. V. $\frac{15}{40}$. The test with glasses indicated compound myopic astigmatism; but an examination under atropine was deemed necessary, when the following state of refraction was found: R. V. $\frac{15}{10}\bar{0}$, L. V. $\frac{15}{50}$. O. D. +40° ax. 90° ⌒ —24° ax. 180°, V. $\frac{15}{15}$ and lines correct. O. S. +144° ax. 90° ⌒ —48° ax. 180°, V. $\frac{15}{20}$ and lines correct. After recovering from the effects of the mydriatic, this prescription was made: O. D. +48° ax. 90° ⌒ —30° ax. 180°. O. S. —48° ax. 180°. These glasses have been worn with comfort and relief from headaches.

Case XXV.—Mrs. F. S—— had for years suffered from severe periodic headaches and sleeplessness at night. Vision was indistinct, and the eyes tired on using them long. R. V. $\frac{15}{50}\bar{0}$, L. V. $\frac{15}{80}$. O. D. +48° ax. 115° ⌒ —48° ax. 25°, V. $\frac{15}{15}$ and lines correct. O. S. +72° ax. 65° ⌒ —72° ax. 155°, V. $\frac{15}{15}$ and lines correct. Under atropine the test was: O. D. +24° ax. 115° ⌒ —144° ax. 25°, V. $\frac{15}{15}$ and lines correct. O. S. +36° ax. 65°, V. $\frac{15}{15}$ and lines correct. In this case the former prescription was made, as the glasses seemed more comfortable than the latter, after recovery from the mydriatic. They have given her great relief up to the present time, nearly two years, but have not effected a perfect cure for she cannot be induced to use them constantly. A change to the latter test will probably be rendered necessary ere long.

Difference in the refraction of the two eyes is of not unfrequent occurrence, and requires some consideration. Usually it is the same error, but differing in degree; thus there will be hyperopia or myopia in one eye, and the same anomaly in

the other eye, only more pronounced. Again, we frequently observe cases with hyperopia or myopia in both eyes, and in addition to this, an astigmatism in one but not in the other. The difference between the two eyes is not, however, limited to degree, for errors of the most reverse type may be found in the same patient, as myopia in one eye, and hyperopia in the other, or simple astigmatism in one, and a compound or mixed astigmatism of a contradictory character in the other. But we must not conclude from this variation in refraction of the eyes, that there must necessarily be exercised a greater muscular strain, for the patient will not uncommonly learn to suppress the image in one eye, thereby limiting the strain to the least ametropic eye. Sometimes the difference in refraction is even an advantage, as for instance, if there is hyperopia in one eye and myopia in the other, they may use the farsighted eye only for distance, and the nearsighted one for near vision, thus diminishing the strain to the minimum, and postponing the wearing of glasses to a much later period in life. Binocular vision is not always an advantage, though when it can be brought about, with ease to the eyes, our endeavor should be to make the two eyes act together, and thus divide the labor and attendant strain. Theoretically, it would be advisable to always correct the existing errors in both eyes, but practically it is not usually best to do so.

An almost unlimited variety of differences in refraction of the eyes could be given, but two or three typical cases will sufficiently illustrate the class.

Case XXVI.—Bertha V——, 17 years of age, had for years complained of headache, and for one year it had been almost constant. The pain was usually dull, occasionally sharp, and especially severe in the frontal region; it was always better when in the open air. She was very nervous, and the general health was poor. V. $\frac{15}{15}$. No manifest hyperopia or astigmatism could be detected. Under atropine, V. $\frac{15}{20}$. O. D., H. $\frac{1}{48}$ + Ah. $\frac{1}{48}$, O. S., H. $\frac{1}{30}$. Ten days after the above test the following glasses were found most comfortable, and were prescribed. O. D. + 72 ax. 85°, O. S. + 60°. Nine months later her mother wrote that the glasses had been worn with great comfort, and her general health had greatly improved, notwithstanding an attack of hay fever.

Case XXVII.—Mabel L—— was brought to me in October, 1884, for indistinctness of vision, pain in the eyes, and lachrymation, especially on any reading or studying, together with some headache over the eyes. R. V. $\frac{15}{30}$, L. V. $\frac{15}{20}$. —50° R. V. $\frac{15}{15}$, —40° L. V. $\frac{15}{15}$. She was using —48 for

distant vision, which gave partial relief, although the eyes seemed to be growing worse. It was also noticed that she held the book much nearer than could be expected in so low a degree of myopia, so paralysis of the accommodation by atropine was recommended. A very material change in the test was then discovered. R. V. $\frac{15}{20}$, L. V. $\frac{5}{15}$ difficulty; + 48 axis 90°, R. V. $\frac{15}{15}$, and lines correct in all meridians; — 144 axis 180°, L. V. $\frac{15}{15}$, and lines correct. These glasses were advised for constant systematic use, and Jaborandi was given internally. Four weeks later, being then able to read without any unpleasant symptoms one hour and a quarter three times a day, she was allowed to return to school.

Case XXVIII.—Mr. B——, aged 55, had, for two years, experienced most intense headaches every week or ten days. They would come on in the morning, and continue until the sun went down. The pain would be worse on the left side, and extend to the occiput; it seemed, as he expressed it, "as if the head would go off," from the severity of the pain. The eyes would tire, and the headache be aggravated by reading or writing. There was double vision on looking downward and to the right. A concave cylinder combined with a prism for left eye, and simple spherical for the right, had given him some relief one year previous to my seeing him. R. V. $\frac{15}{15}$, L. V. $\frac{15}{30}$. A careful examination revealed hyperopia in right eye, and mixed astigmatism with paresis of the inferior rectus muscle in left eye. It was corrected by the following prescription: O. D. + 60, O. S. + 72 axis 45° ⌒ — 144 axis 135° ⌒ prism 1°, base downwards. To this, for his presbyopia, a + 18 was added for near vision. One year later, he reported that he had had no headaches since wearing his glasses. On account, however, of slight tiring of the eyes, his spherical was changed to 48, and his prism increased to 2°.

Presbyopia.

All our attention has hitherto been directed to errors in refraction, which have caused the strain upon the accommodation; but, independent of these errors, we may have disturbances in the accommodation, which will produce cerebral complications. First in order is presbyopia, in which the power of accommodation is diminished by age, as indicated by the recession of the near point, or the desire to hold the book farther away. This is due to senile changes in the lens and ciliary muscle, which render an extra effort of the accommodation indispensable to see near objects distinctly, thus bring-

ing about eye strain. It is a condition that occurs not only in the emmetropic eye, but in all anomalies of refraction. Illustrative of its influence upon the head are the following cases:

Case XXIX.—Mrs. T——, about 55 years of age, was seen in May, 1881, for frontal headaches brought on by using the eyes. Refraction was Em. Pr. $\frac{1}{4}$. Convex 24 were prescribed with relief of headache. In December, 1883, the headache returned. She would awake nearly every morning with pain in the occiput, which would settle over the right eye, with nausea and vomiting. The eyes would smart and burn on reading, soon followed by pain in the head. Rest of the eyes benefited the headaches. Convex 18 were then prescribed, and Sanguinaria given internally. It is now one year, and she writes that she has experienced no pain in the eyes or head since last date.

Case XXX.—Mrs. D——, æt. 52, came for treatment in April, 1881. For four years the vision had been growing dimmer, and the eyes weaker, so that, upon attempting to read even a few minutes, there would be smarting and pain in the eyes, with much nausea. R. V., $\frac{15}{70}$, L. V., $\frac{15}{40}$. Refraction, Em. Pr. $\frac{1}{4}$. The ophthalmoscope showed commencing cataract in both eyes. Remedies were given to check the progress of the cataracts most of the time, until February, 1883, when R. V. $\frac{15}{15}$, L. V. $\frac{15}{15}$. Still she could not read without great discomfort, even with convex 10 glasses, which seemed correct. The cause of this was found to be weakness of the internal recti muscles. The convex 10 lenses were, therefore, decentered inwards so as to obtain a prismatic effect, and thus relieve the strain on these muscles. They gave immediate relief, and, at this time of writing, she is able to read or write as much as she desires, and with comfort.

A second form of disturbance in the accommodation is a so-called "premature presbyopia," or paresis (weakness) of the accommodation. Here we may find a recession of the near point in early life, or even this may not be apparent, as in the following case:

Case XXXI.—Mr. M——, a bookkeeper, had for a long time suffered from daily headaches over and behind the eyes, with dull pain in them. He was nervous and languid. No error in the refraction, with the exception of a very slight hyperopic astigmatism ($\frac{1}{2}$) in one eye, could be detected, even under atropine. Weakness of the accommodation was diagnosticated, and convex 50 were given for his writing. These glasses gave great relief, but he is still under treatment directed to the "toning up," not only of his ciliary muscle,

but also of his general strength. This class of cases may require the aid of glasses for a certain time, but our chief reliance must be placed upon the remedial treatment in the accomplishment of a permanent cure.

The reverse condition to the above is *spasm of the accommodation*. This subject has been well considered in the various anomalies of refraction, so that very little need be said in this connection. Its influence in producing disturbances in the nerve centres has been apparent in a large number of the preceding cases. When its origin can be traced to an error in the refraction, this must first be corrected; but often in these cases, as well as in others in which no trouble of this kind can be discovered, more than glasses will be required. It is often here that the local use of mydriatics will render serviceable aid, or we may place our reliance upon internal medication either specially or generally indicated.

Weakness of the External Ocular Muscles.

It was my purpose to consider in detail the weakness of the recti and oblique muscles in their relation to secondary disturbances, as has been done with the ciliary muscle, but the intended limits of this paper have already been exceeded so that only a hurried glance can be directed to this division.

The internal rectus is more often at fault than all the others combined. When the asthenopic or nervous symptoms are not relieved after the correction of the existing anomaly of refraction, it should be our duty to carefully determine the relative strength of the external muscles. This can easily be done by an examination with prisms. If one muscle should prove to be unquestionably weaker than normal, it may be sufficient to produce the disturbance of which the patient complains; in which case our attention should be turned to the strengthening of this muscle or relieving the strain brought to bear upon it. Correction only of the error in refraction may suffice to accomplish this object, as has been demonstrated in weakness of the internal recti dependent upon myopia. Again we relieve the tension upon the weakened muscle by decentering the lenses as in case xxx., or by the addition of a prism as in case xxviii. It is not, however, always advisable to diminish this strain, but rather endeavor to tone up the muscle so that it will withstand the increased amount of work devolving upon it. This can often be done by systematic exercise with stronger and stronger prisms, so arranged as to only bring into action the enervated muscle; also by the employ-

ment of electricity and internal medication as adapted to the individual case. In some instances tenotomy of the antagonistic muscle is necessary, but these are exceptional cases.

Summary.

In conclusion let me briefly summarize, for the benefit of the general practitioner, the chief points which it has been my object to elucidate in this article, and also state a few deductions which may be drawn from my experience. Headache in any portion of the head, but especially in the frontal region; headache in which the pain may be of any character whatever; headache severe or mild; headache periodic or constant; headache with or without vertigo or nausea, *may* result from errors in refraction. Various nervous disturbances, as mental disorders, insomnia, spinal irritation, general nervousness, etc., *may* be dependent upon the same cause. The physician now naturally inquires, how are we to know that the cause is ocular, and what indications should lead us to send these patients to a specialist for examination, providing we do not care to make the test ourselves? The following general rules are the only ones that can be advanced: When headaches or other symptoms are made worse or brought on by use of the eyes, even though the aggravation is not experienced until the day following overuse, an examination of the eyes should be made. If asthenopic symptoms are complained of after reading, writing, or sewing, even though no direct connection can be traced between these symptoms and the headaches, an examination of the refraction should be advised. In all cases of chronic headaches and cerebral or spinal symptoms, in which the causes are obscure and the treatment obstinate, a careful test of the refraction may discover some error, or at least aid in the diagnosis by excluding the eye as an agent in causing the trouble.

To be positive in the diagnosis of anomalies of refraction, an examination of the eyes when fully under the influence of atropine is necessary. This test can, however, in the majority of cases, be dispensed with if there should be any objection to its use. Correction of the faulty refraction is often all that is sufficient to produce a permanent cure. But frequently, upon the other hand, this correction will only ameliorate the condition, and other treatment will be required to complete the cure. This further treatment may consist of regular systematic exercise of the weakened muscle or muscles, the employment of electricity, the administration of remedies for the local disorder, or, more especially, internal medication directed to the toning up of the

whole nervous system. Myopia more often occasions weakness of the internal recti muscles, while the accommodation is more commonly impaired in hyperopia, astigmatism and presbyopia. Astigmatism, particularly, causes derangements in the nerve centres. It is surprising how low a degree of abnormal curvature will, in some cases, produce the most serious complications; and, again, it is just as wonderful how high a degree may sometimes be present without developing any indications of eye-strain or its consequences. It is not generally advisable to wholly neutralize the full degree of myopia or hyperopia, and even in astigmatism it is not always possible to correct all the irregular curvature, though this should be done as nearly as comfort will allow. Errors in refraction do not as frequently induce secondary disturbances in adults as in young persons, and they cannot usually be as fully corrected in the former as in the latter; for the eye of the adult has become so accustomed to working in an abnormal manner that irregular action of the muscles has become its normal action, and they (the muscles) cannot at once relax sufficiently to accommodate their action to correcting lenses. Therefore, we may meet with a case of headache really due to refractive error, and yet its exact correction will not only not ameliorate, but even aggravate the trouble. In these instances, repeated and careful trials with glasses are very necessary, as oftentimes it will be advisable to only partially correct the error, sometimes to wholly correct, now and then to combine prisms, and again, even an over-correction may be required.

Before closing, let me again say that no claim is made in this paper that all, or even a majority, of headaches, or all headaches or nervous disturbances of any particular type, even though accompanied by asthenopic symptoms and aggravated on reading, are necessarily dependent upon the eyes. I only assert that the eye is a very important agent in causing these secondary disturbances, and should be so recognized. The reverse condition is also just as true, that uterine disorders, cerebral or spinal diseases, and various constitutional troubles, may cause eye complications. The consideration, however, of this latter subject, together with the completion of the one now under examination, by a study of the weakness of the other ocular muscles, and the relation of inflammatory diseases of the eye to cerebral and spinal disorders, must be postponed to future papers, since the intended limits of this article have already been far surpassed.

154 West 34th Street, New York City.